



The Commonwealth of Massachusetts

*County of Plymouth*  
**Sheriff's Department**

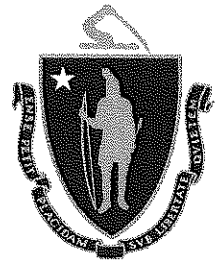
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Accredited by:



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July 19, 2012

**RE: RESPONSE TO REQUEST FOR INFORMATION**  
**DATED JULY 13, 2012**

1. Equipment description and capacities:
  - a) The date of installation of the gasification unit and boiler;
    - a. Shipped on 5/31/12.
      - i. Waste Preprocess and gasification unit install completed by 6/18
      - ii. Boiler installation completed on 7/17/12
  - b) The date the gasification unit and boiler began operation;
    - a. Subsystem verification testing began on 6/19/12
      - i. Test included evaluation of Preprocess and gasification system functionality and waste characterization.
      - ii. Tests were conducted on 6/19/12, 6/20/12, 6/21/12 and 6/26/12.
    - b. Boiler has not been operated, installation was completed on 07/17/2012
  - c) A description of the composition and quantity of the feedstock, including volume/tonnage, introduced into the gasification unit on a daily basis;
    - a. Composition
      - i. The Facilities waste (jail and administration building) consists of cafeteria, office and inmate

wastes. The waste contains food, cardboard, paper, plastic and textiles that were not able to be recycled.

b. Volume/Tonnage

- i. The Facility generates ~1 ton/day which will be processed in the waste-to-energy system during an 8 hour period.
  1. The gasification unit can operate at a max of 200 lbs/hr of feedstock at 10% moisture, or 4800lb/day.
- ii. The waste-to-energy system will operate Monday-Friday from 8am to 4pm.
  1. IST Energy may also perform several duration tests ranging between 24 and 144 continuous hours of operation.
- iii. The duration of the program is for 6 months. The contract for the pilot program will close on 12/1/12.
  1. A six month extension of the contract has been discussed but is not emanate at this time.

d) Quantity of restricted materials (as listed *Table 310 CMR 19.017 (3)*) used as feedstock for the gasification unit on a daily basis;

The existing recycling program will remain in place at the Plymouth County Correctional facility.

Specific answers to the Restricted Materials from Table 310CMR 19.017(3) are listed below.

- a. Lead Batteries – None
- b. Leaves – None
- c. Tires – None
- d. White Goods – None
- e. Other Yard Wastes – None
- f. Aluminum Containers – None (inadvertent material will be removed by waste pre-processor)
- g. Metal or Glass – None (inadvertent material will be removed by waste pre-processor)
- h. Single Polymer Plastics – All non-contaminated single polymer plastics will continue to be recycled with the existing recycling program
- i. Recycled Paper – None
- j. Cathode Ray Tubes – None
- k. Asphalt Pavement, brick and concrete – None
- l. Metal – None (inadvertent material will be removed by waste pre-processor)
- m. Wood – None
- n. Clean Gypsum Wallboard – None

e) Total number of hours the gasification unit and boiler will operate per day and per month;

- a. Typical week will be 40 hours of operation (8 hrs/day), typical month is 160 hours.
- f) Quantity (volume) of syngas produced per hour and per day;
  - a. Typical syngas flowrates are 130 SCFM (7,800 SCFH or 62,400 SCFD).
- g) Heat capacity, in Btus, of the syngas;
  - a. 150-190 BTU/ft<sup>3</sup>
    - i. 1,170,000 BTU/hr up to 1,482,000 BTU/hr
- h) Additional / supplemental fuel(s) used by the gasifier, identifying the firing rate of the supplemental fuel and under what circumstances the supplemental fuel will be used;
  - a. Wood Char used during cold start up of reactor. 200 lbs of wood char is used over an hour to develop a hot char bed prior to waste pellets being added to the reactor. Expectation is one cold start up per week.
- i) Supplemental fuel(s) used by the boiler, identifying the firing rate of the supplemental fuel and under what circumstances the supplemental fuel will be used;
  - a. If necessary, propane may be used for startup and shutdown to supplement flare gas if the gas being generated by the gasifier will not maintain a flare.
- j) Make, model, and size of the boiler and associated burner. Burner size should be identified in both horsepower and Btus per hour.
  - a. Boiler Weil McClain Series 88
    - i. 59.4 Boiler Horsepower
    - ii. Gross output megabtu/hr 1.987
  - b. Burner Eclipse ThermAir TA200
    - i. 55.9 Boiler Horsepower
    - ii. 1.871MBTU/hr

## 2. Equipment Operation:

For the duration of the pilot operation of the system at the Plymouth County Correctional Facility, IST Energy will own and operate the equipment. During this pilot operation, waste normally directed to the existing compactors for waste hauler removal will be brought to the waste-to-energy system. IST Energy personnel will oversee the operation of the equipment. All maintenance procedures and waste handling into the waste-to-energy system will be conducted by IST Energy staff.

The Plymouth County Correctional Facility generates about 1 ton of waste material hauled for disposal each day. This waste is primarily cafeteria waste and includes plastic packaging for inmates who are delivered meals to satellite locations. Other waste from the facility includes office waste from correctional staff and inmate generated waste from the cells.

The existing recycling program at the Plymouth County Correctional Facility will continue to divert recyclables. The system in place is inspected by Mass DEP and the Department of Corrections for compliance with the waste ban.

During this pilot it is anticipated that the waste-to-energy system will operate for eight hours each day to convert the waste generated by the facility into energy. The system will be started Monday through Friday in the morning (at approximately 8am) and operate until the days waste is converted (typically within 8 hours). Waste will be delivered after each meal of the day. The IST Energy staff will operate the waste-to-energy system 5 days of each week.

The ash produced by the gasifier will be periodically TCLP tested to verify that it can be disposed in a MSW landfill. It is not anticipated that any toxic leachates will be found in the feedstock material or the ash because of the controlled environment the waste is being generated from.

The system is controlled by a PLC based control system. Feedstock is added by the operator when feedstock level indicators show that the system is ready for additional material. Extensive operating variables are measured throughout the entire process. The control system is designed to optimize material processing while minimizing power usage within the system.

#### Waste Pre-Processor

The waste pre-processor begins by shredding the feedstock. A four shaft rotary shredder is used to reduce the feedstock material (waste) piece size to a maximum of 20mm. The amount of material in the shredder is electronically controlled so if there is no material to shred, it is shut off. This electronically controlled shutdown logic is applied to all processing steps within the waste-to-energy system. If there is no material to process, that portion of the system is automatically shut down to reduce energy consumption and overall system parasitic loss. From the shredder, material is conveyed to the dryer. The material passes by a continuous moisture sensor before going into the drying unit. The moisture content will dictate how much hot air should be supplied to the dryer. The heat is developed from a heat recovery process (heat exchanger cooling the produced syngas) in the gasifier system and is ducted to the dryer. The moisture level of the outlet of the dryer is measured to ensure proper drying occurred. If the product leaving the dryer is out of spec the control system will adjust the retention time of the material in the dryer to correct. Undesirables are then separated using a density separator and then the remaining material is compressed into fuel pellets 12mm in diameter and 20-40mm in length.

The amount of material which is turned into pellets is electronically weighed so throughput of the pre-processor and gasifier can be quantified.

The amount of current on all motors is monitored to determine loading condition of each processing step. If any motor begins to cross its normal operating threshold an alarm condition is signaled and the system will continue to monitor the motor until the system either comes back down to normal operating amperage or increases to a fault condition. If a system faults, the faulted operation and all prior operations are automatically suspended until the fault is corrected.

The waste pre-processor is capable of processing 3 tons of material in 12-14 hours. This will maintain a duty cycle of the system within 50%-60%. One ton of feedstock material supplied from the Plymouth County Correctional Facility will be processed into fuel pellets within 4-5 hours of operation. This one ton of feedstock will result in approximately 1600lb of pellets for the gasifier to convert into syngas because of the moisture removed in the Pre-Process dryer.

### Gasifier

A downdraft gasification system is used to convert the solid fuel pellet into a synthetic gas product. It is important to maintain an optimal temperature profile within the gasifier to produce the highest carbon conversion rate and lowest tar output product. There are temperature probes in each of the nine zones of the gasifier to ensure a consistent temperature profile. Temperatures are electronically maintained at the proper levels within the gasifier by adjusting the amount of ambient air being drawn into the gasifier at different vertical heights. Seven of the nine zones have controlled secondary air introduced into the gasifier to control the different chemical reactions within the gasifier. These zones control the four major reaction schemes in the process. The first is a drying stage where the pellets are in a zone above 100°C and moisture is removed. The material then enters a pyrolysis stage where the volatile matter is removed from the pellet in the form of gas. The other product of this process is char. The pyrolysis stage operates between 400 and 800°C. The next part of the reactor combusts the gasses developed in the pyrolysis stage and performs char reduction. This process develops CO<sub>2</sub> and H<sub>2</sub>O as well as reduces the remaining char material. This stage operates at temperatures between 1000 and 1200°C. The final stage of the reactor performs a reduction reaction where CO<sub>2</sub> and H<sub>2</sub>O are converted into H<sub>2</sub> and CO. This is done when the gas enters a region of the reactor where oxygen is absent and the high temperature and char allow for the reduction reaction to occur. The product that leaves the

reactor consists of CO, H<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>, CO<sub>2</sub> and H<sub>2</sub>O. The pressure differential across the base of the gasifier is also electronically monitored and the vacuum adjusted to maintain the proper gas pressure and velocity within the entire system. Since the entire gasifier system is operated under negative pressure, there are no emissions released during the process. The synthetic gas (syngas) goes through several conditioning steps to provide a suitable product for downstream use. The conditioning consists of particulate filtering and syngas cooling.

### Boiler

The syngas generated by the gasifier is piped from the gasifier through steel piping to a boiler located in another container. The syngas is fired in a Weil McLain Series 88 boiler using an Eclipse ThermAir Model TA200 burner. This combination allows efficient energy harvest of the syngas. A propylene glycol/water heat transfer liquid loop is used to pre-heat the hot water circulation system within the jail. This reduces the overall heating load for the water heaters located in the jail and reduces natural gas usage for the facility.

With the efficiency of the boiler/burner combination and the heat transfer loop it is expected that the boiler running on syngas will be able to supply the Plymouth County Correctional Facility with 1.0 MMbtu/hr (or 10 Therms/hr) of heat in the existing hot water system during the pilot program.

### 3. Regulatory Applicability

- a. Michael Cheney, Director of Project Management, representing the Plymouth County Correctional Facility, IST Energy, Mass DEP and the USEPA met on 07-17-2012 in Boston to discuss the operations within the Waste-To-Energy system. Attendees include Ian Cohen, Donald Dahl, Amy Hambrick, Marsha Mia, Mark Wolman and Karen Regas. The purpose of the meeting was to review the waste-to-energy systems operation. No determination as to the regulatory applicability of small-scale waste-to-energy conversion systems has been made and it was suggested that any decision must be approved by EPA headquarters. Ian Cohen recommended checking in during the week of 07-23-12 for a status update.

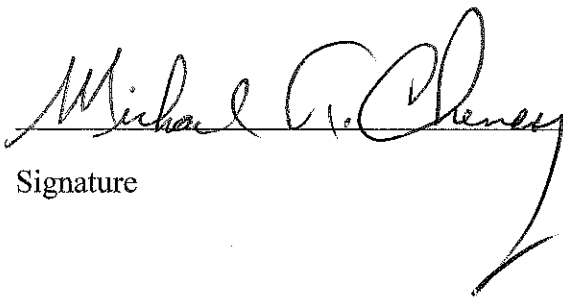
ATTACHMENT

CERTIFICATION STATEMENT

This certification must be included with your response to the Request For Information.

"I Michael T. Cheney certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including possible fines and imprisonment."

By:



Signature

07/19/2012

Date

Title: Director, Project Management

For: Plymouth County Sheriff's Department

Name of person or entity